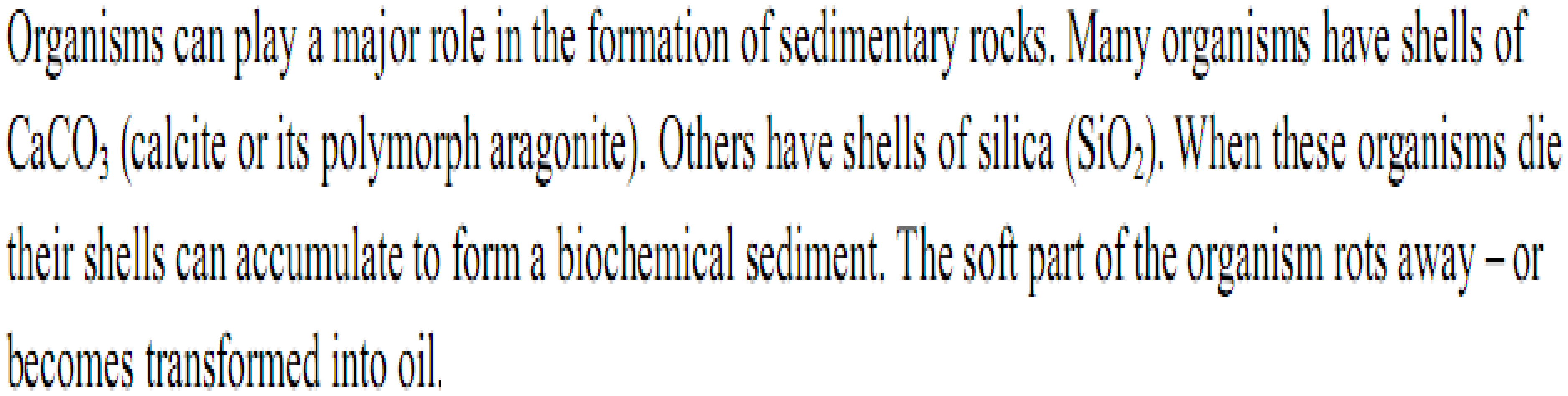
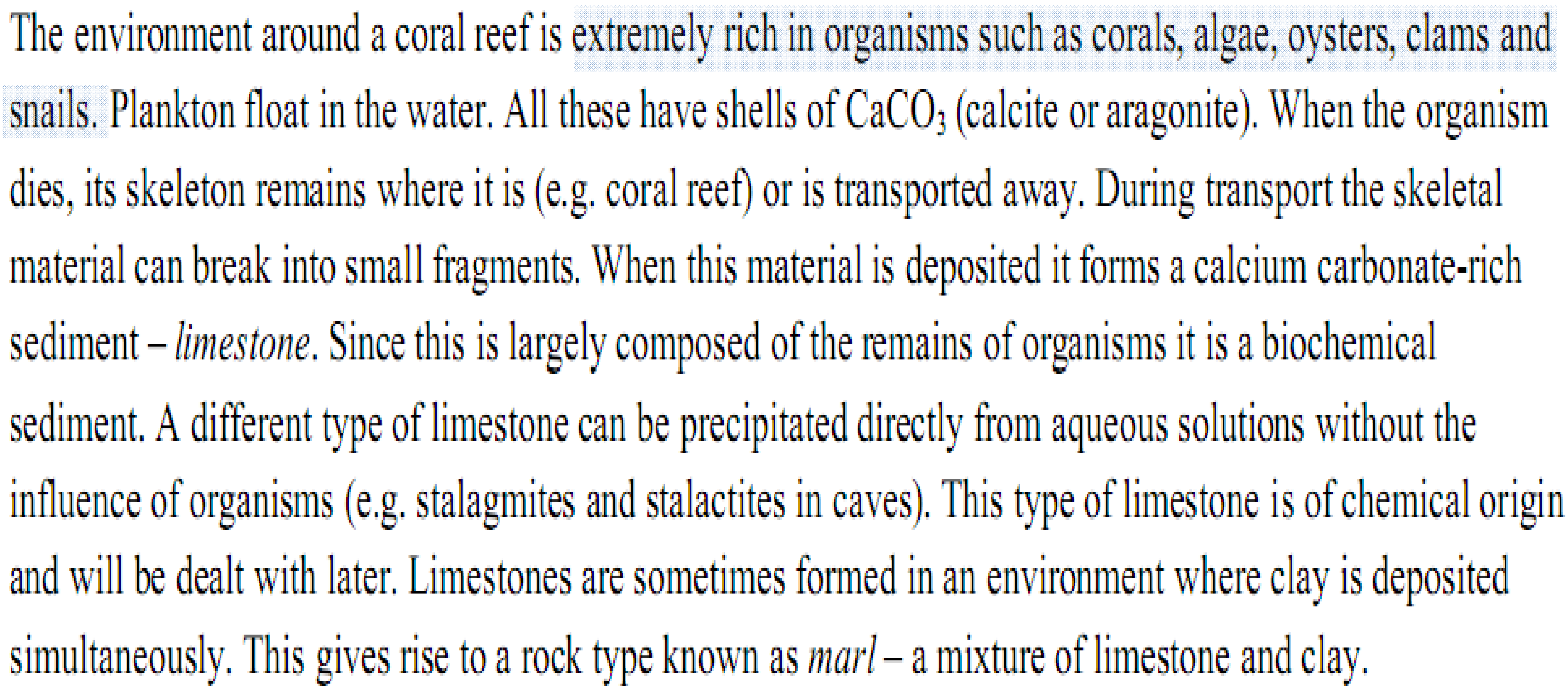
Biochemical Sedimentary Rock

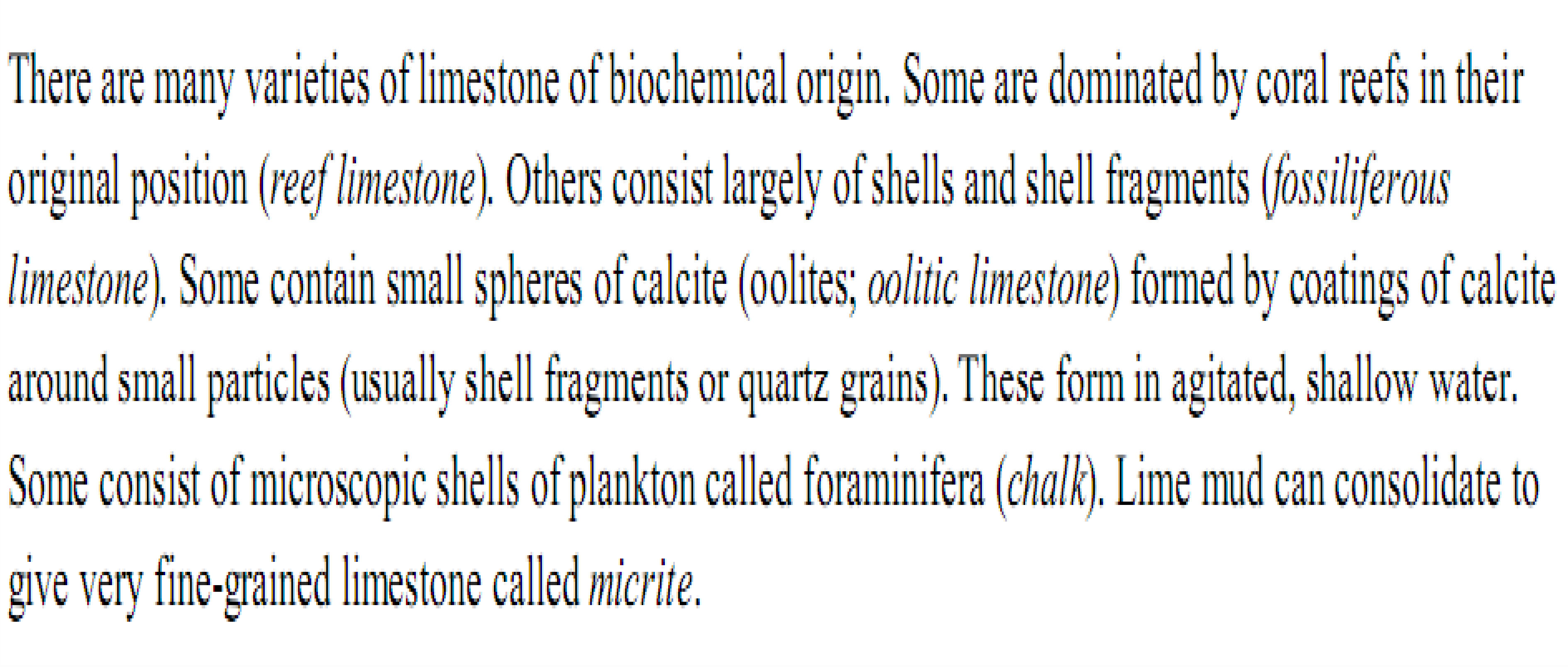


Organisms can play a major role in the formation of sedimentary rocks. Many organisms have shells of $CaCO_3$ (calcite or its polymorph aragonite). Others have shells of silica (SiO_2). When these organisms die their shells can accumulate to form a biochemical sediment. The soft part of the organism rots away – or becomes transformed into oil.

BY : JHONNY



The environment around a coral reef is extremely rich in organisms such as corals, algae, oysters, clams and snails. Plankton float in the water. All these have shells of $CaCO_3$ (calcite or aragonite). When the organism dies, its skeleton remains where it is (e.g. coral reef) or is transported away. During transport the skeletal material can break into small fragments. When this material is deposited it forms a calcium carbonate-rich sediment – *limestone*. Since this is largely composed of the remains of organisms it is a biochemical sediment. A different type of limestone can be precipitated directly from aqueous solutions without the influence of organisms (e.g. stalagmites and stalactites in caves). This type of limestone is of chemical origin and will be dealt with later. Limestones are sometimes formed in an environment where clay is deposited simultaneously. This gives rise to a rock type known as *marl* – a mixture of limestone and clay.



There are many varieties of limestone of biochemical origin. Some are dominated by coral reefs in their original position (*reef limestone*). Others consist largely of shells and shell fragments (*fossiliferous limestone*). Some contain small spheres of calcite (oolites; *oolitic limestone*) formed by coatings of calcite around small particles (usually shell fragments or quartz grains). These form in agitated, shallow water. Some consist of microscopic shells of plankton called foraminifera (*chalk*). Lime mud can consolidate to give very fine-grained limestone called *micrite*.

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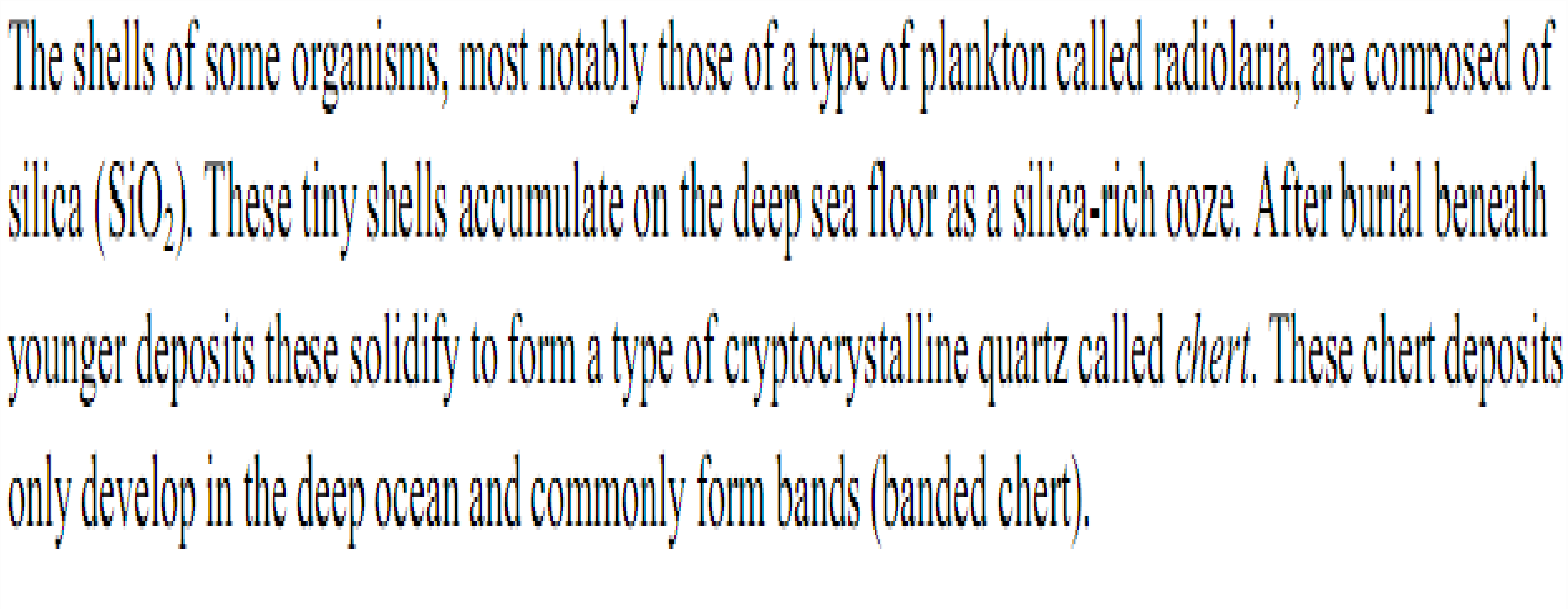

The shells of some organisms, most notably those of a type of plankton called radiolaria, are composed of silica (SiO_2). These tiny shells accumulate on the deep sea floor as a silica-rich ooze. After burial beneath younger deposits these solidify to form a type of cryptocrystalline quartz called *chert*. These chert deposits only develop in the deep ocean and commonly form bands (banded chert).

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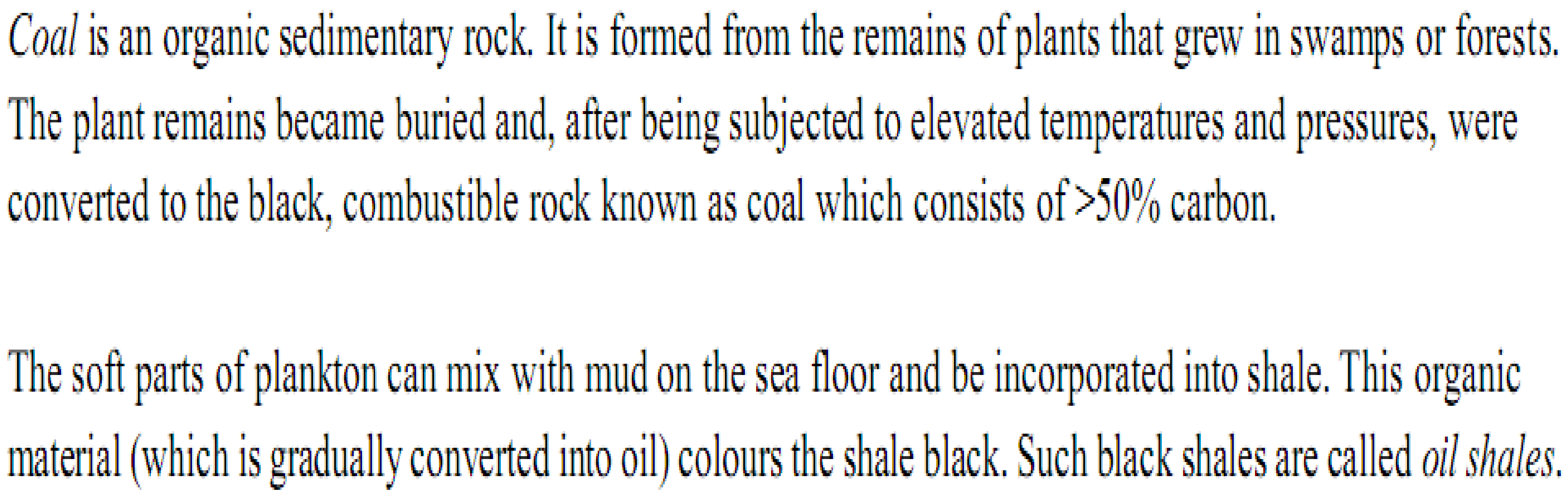
Organic Sedimentary Rock



Coal is an organic sedimentary rock. It is formed from the remains of plants that grew in swamps or forests. The plant remains became buried and, after being subjected to elevated temperatures and pressures, were converted to the black, combustible rock known as coal which consists of >50% carbon.

The soft parts of plankton can mix with mud on the sea floor and be incorporated into shale. This organic material (which is gradually converted into oil) colours the shale black. Such black shales are called *oil shales*.

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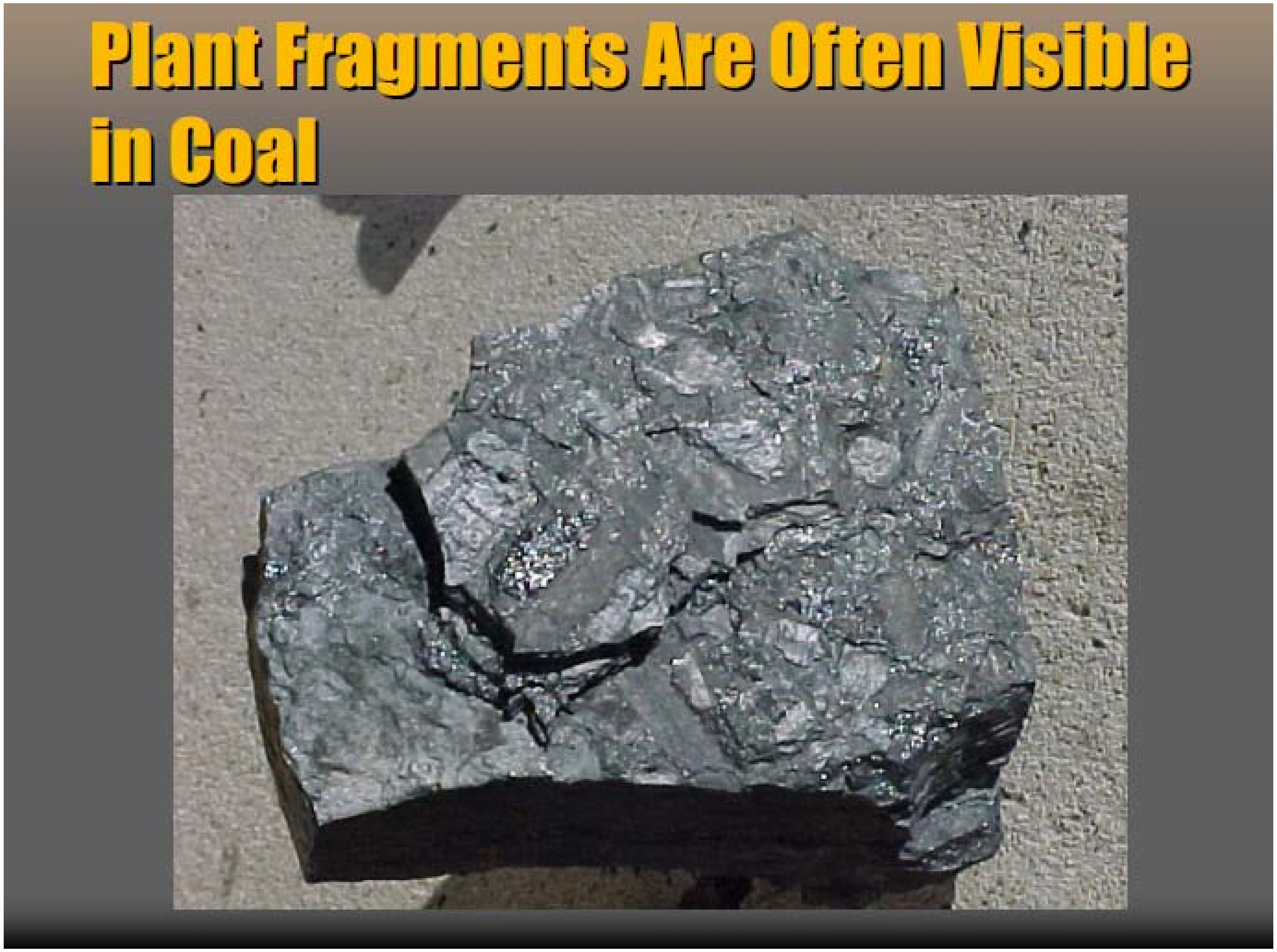

Plant Fragments Are Often Visible in Coal

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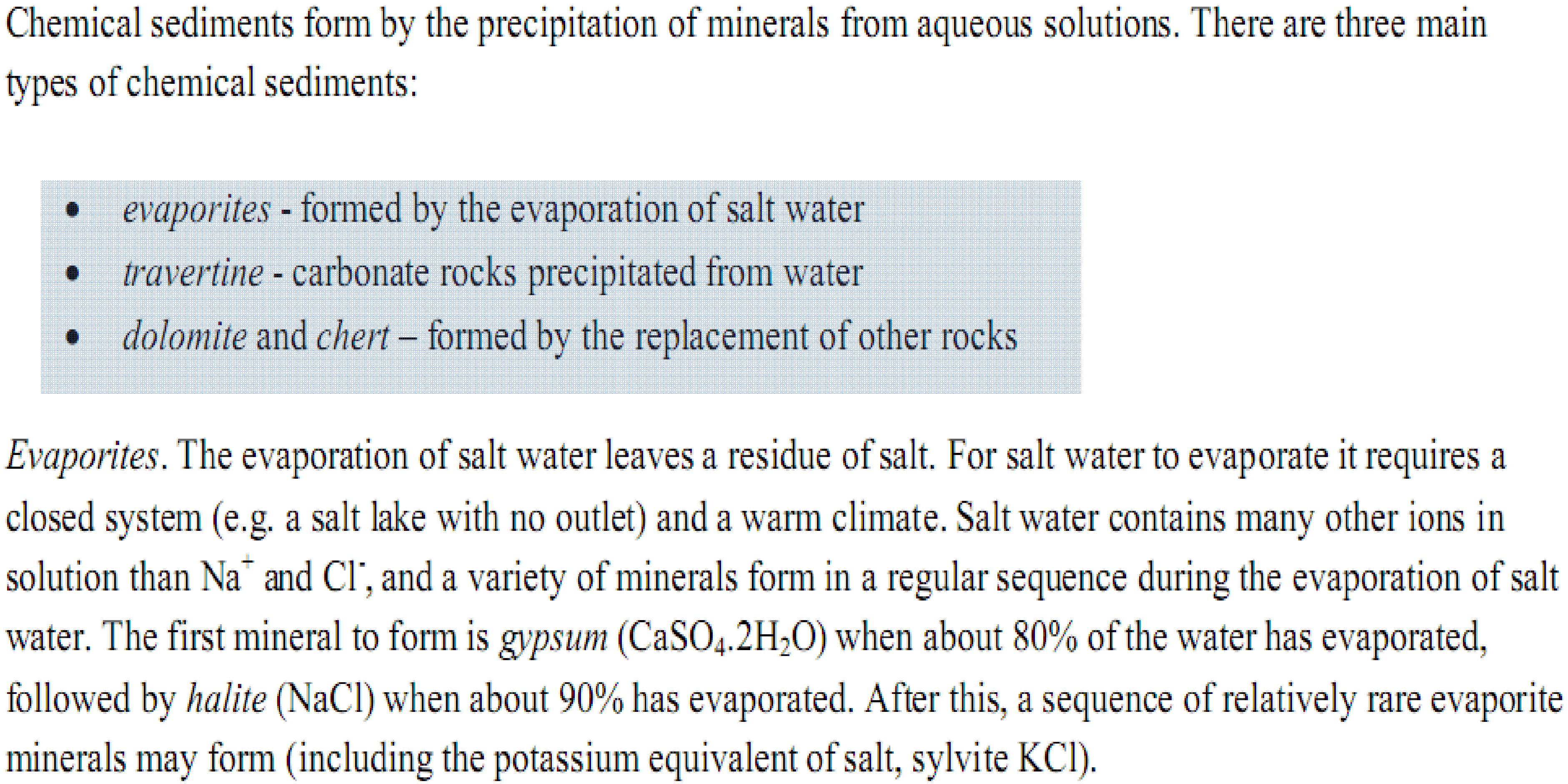
Chemical Sedimentary Rock

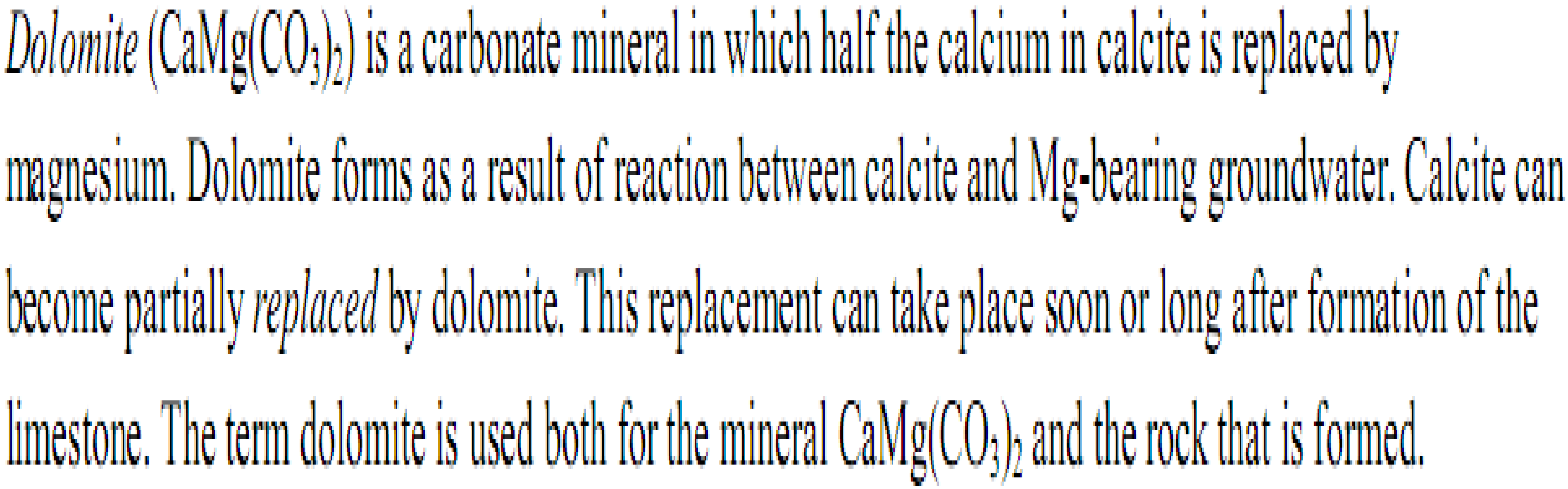


Chemical sediments form by the precipitation of minerals from aqueous solutions. There are three main types of chemical sediments:

- *evaporites* - formed by the evaporation of salt water
- *travertine* - carbonate rocks precipitated from water
- *dolomite* and *chert* – formed by the replacement of other rocks

Evaporites. The evaporation of salt water leaves a residue of salt. For salt water to evaporate it requires a closed system (e.g. a salt lake with no outlet) and a warm climate. Salt water contains many other ions in solution than Na^+ and Cl^-, and a variety of minerals form in a regular sequence during the evaporation of salt water. The first mineral to form is *gypsum* ($CaSO_4.2H_2O$) when about 80% of the water has evaporated, followed by *halite* ($NaCl$) when about 90% has evaporated. After this, a sequence of relatively rare evaporite minerals may form (including the potassium equivalent of salt, sylvite KCl).

As we have seen, limestone can form by the accumulation of biochemical material. It can also, however, form by direct precipitation from water without organisms being involved. This chemical variety of limestone is called *travertine*. Water, especially acidic water, can dissolve calcite in limestone. The carbonate material is, however, commonly precipitated again, often in limestone caves (as stalagmites and stalactites etc.) or around hot springs. Travertine, which is usually banded and beige in colour, is widely used as a facing stone.



Dolomite ($CaMg(CO_3)_2$) is a carbonate mineral in which half the calcium in calcite is replaced by magnesium. Dolomite forms as a result of reaction between calcite and Mg-bearing groundwater. Calcite can become partially *replaced* by dolomite. This replacement can take place soon or long after formation of the limestone. The term dolomite is used both for the mineral $CaMg(CO_3)_2$ and the rock that is formed.

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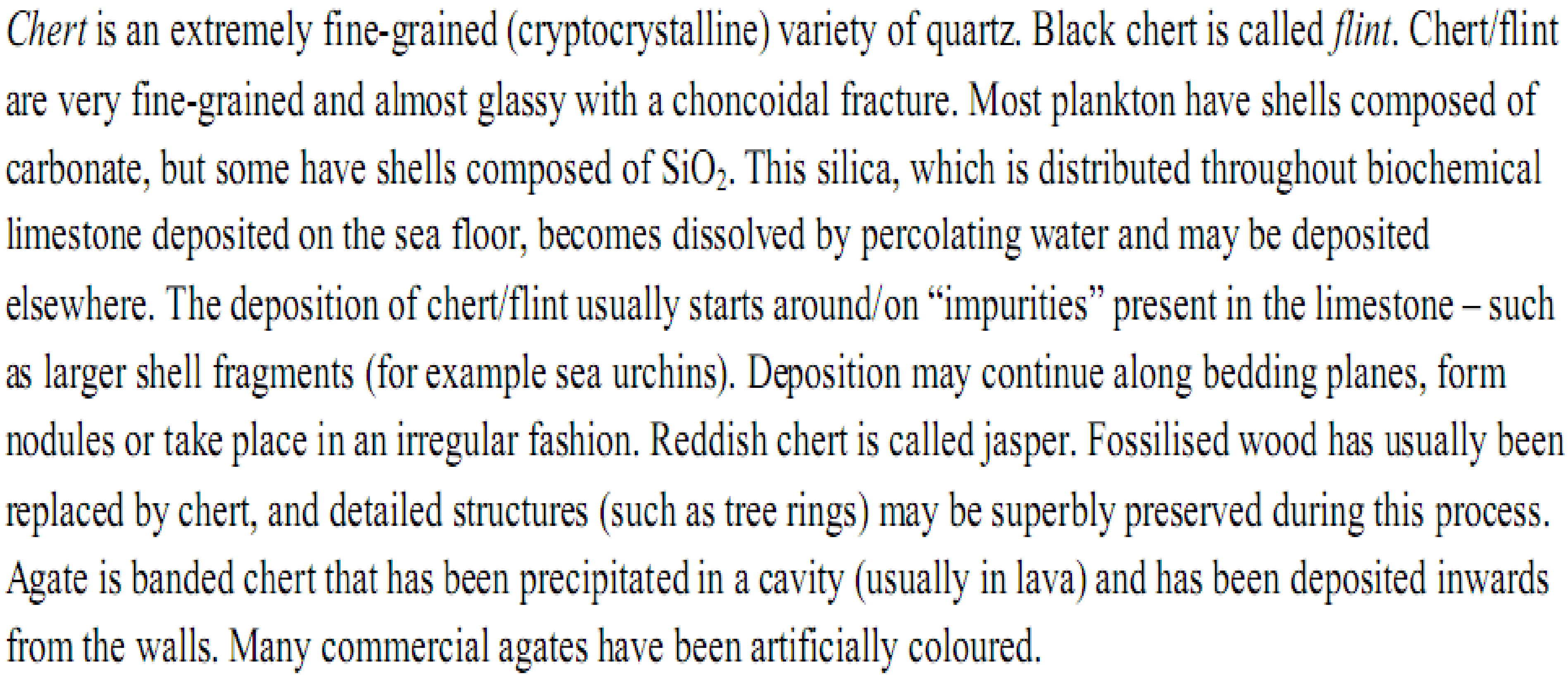

Chert is an extremely fine-grained (cryptocrystalline) variety of quartz. Black chert is called *flint*. Chert/flint are very fine-grained and almost glassy with a choncoidal fracture. Most plankton have shells composed of carbonate, but some have shells composed of SiO_2. This silica, which is distributed throughout biochemical limestone deposited on the sea floor, becomes dissolved by percolating water and may be deposited elsewhere. The deposition of chert/flint usually starts around/on “impurities” present in the limestone – such as larger shell fragments (for example sea urchins). Deposition may continue along bedding planes, form nodules or take place in an irregular fashion. Reddish chert is called jasper. Fossilised wood has usually been replaced by chert, and detailed structures (such as tree rings) may be superbly preserved during this process. Agate is banded chert that has been precipitated in a cavity (usually in lava) and has been deposited inwards from the walls. Many commercial agates have been artificially coloured.

Limestone

- The most abundant chemical sedimentary rock.
- Composed of the mineral calcite.
- Marine limestones form as coral reefs, coquina (broken shells), and chalk (microscopic organisms)
- Inorganic limestones include travertine and oolitic limestone.

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Coral Reef

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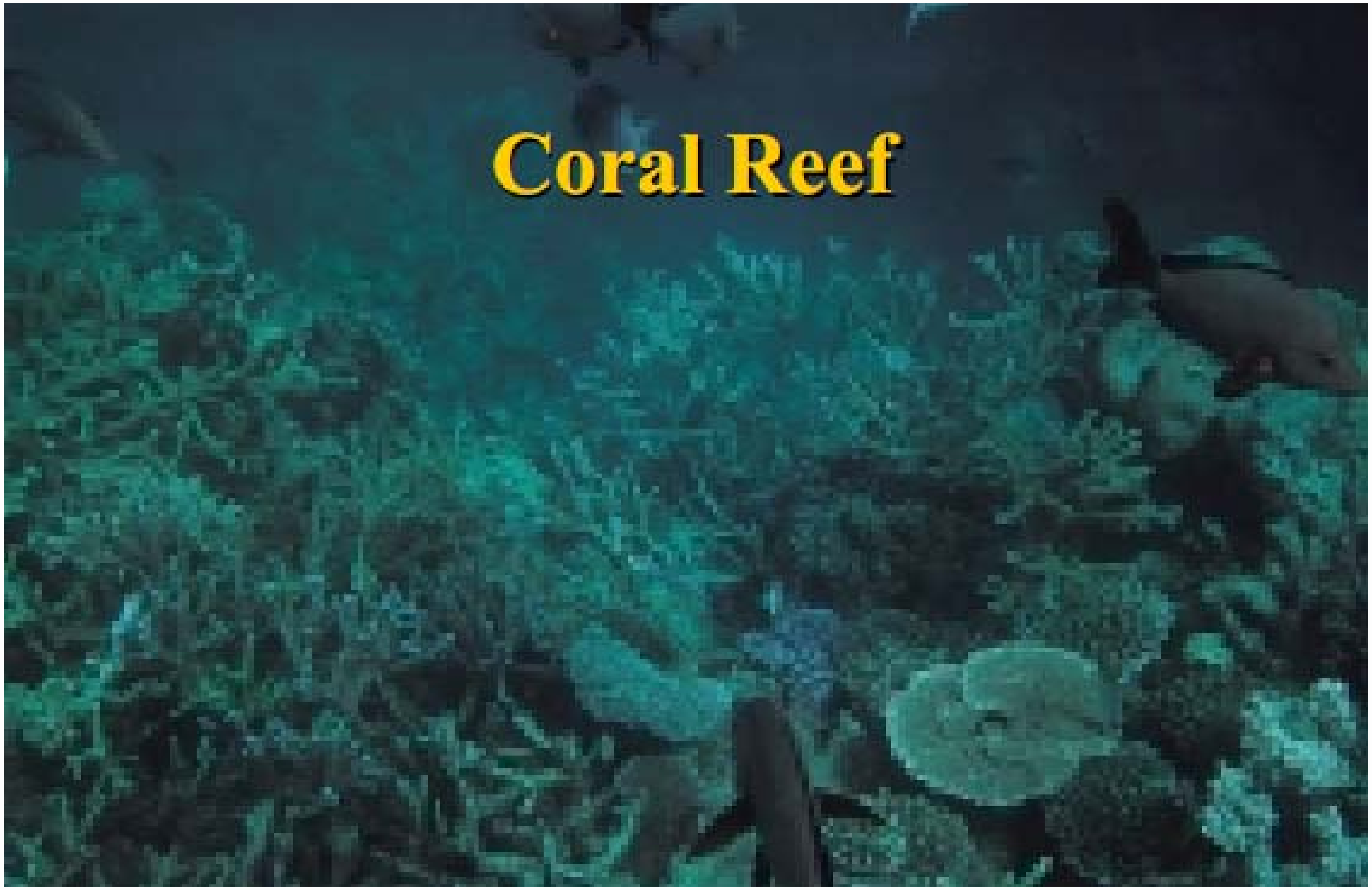

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